Community, Sharing & Responsibility

The iGEM community strives to bring likeminded people together, who wish to use synthetic biology to create a positive impact in the world. Currently 16,000 people have been involved in the iGEM community (iGEM HQ, 2016). However, there are much more people interested in science and these might also be interested in the activities of iGEM.

One of the main activities of the iGEM community is honesty in this field of knowledge and thus to share knowledge. A survey, performed in the UK in 2014, showed that the public still trusts scientists even though they do not always trust the scientific data itself. The trust though is fragile and this gap could facilitate a complete collapse in trust in science (Yarborough, 2014). To prevent this, scientists need to articulate better what makes their work deserving of the public's trust in the first place, according to Yarborough. Sharing knowledge happens both within the iGEM community as well as to external actors such as the remaining scientific world, industry, governments and laymen. Here, we present a strategy to strengthen the iGEM community even more, using its most vital power: sharing knowledge. To enable this, an action mode was planned for each moment in time to ensure involvement in the iGEM community.

Sharing knowledge as main activity of a community

To strengthen the iGEM community, it is important to attract new participants. For this, high school and college students should be motivated to compete. However, to motivate them to change their behavior into an iGEM participating behavior, something more needs to happen than solely attracting and motivating. According to the consumer acceptance of technology model of Kulviwat (2007): to accept a new technology and in this case a new project in their lives as iGEM, it is for any stakeholder important to be positive about it – both cognitive and affective. These two different factors are important and work together to accomplish acceptance and a behavioral change in favor of in this case actively participating in the iGEM community (figure 8). This theory is also applicable for the acceptance of the innovations made within the iGEM community.

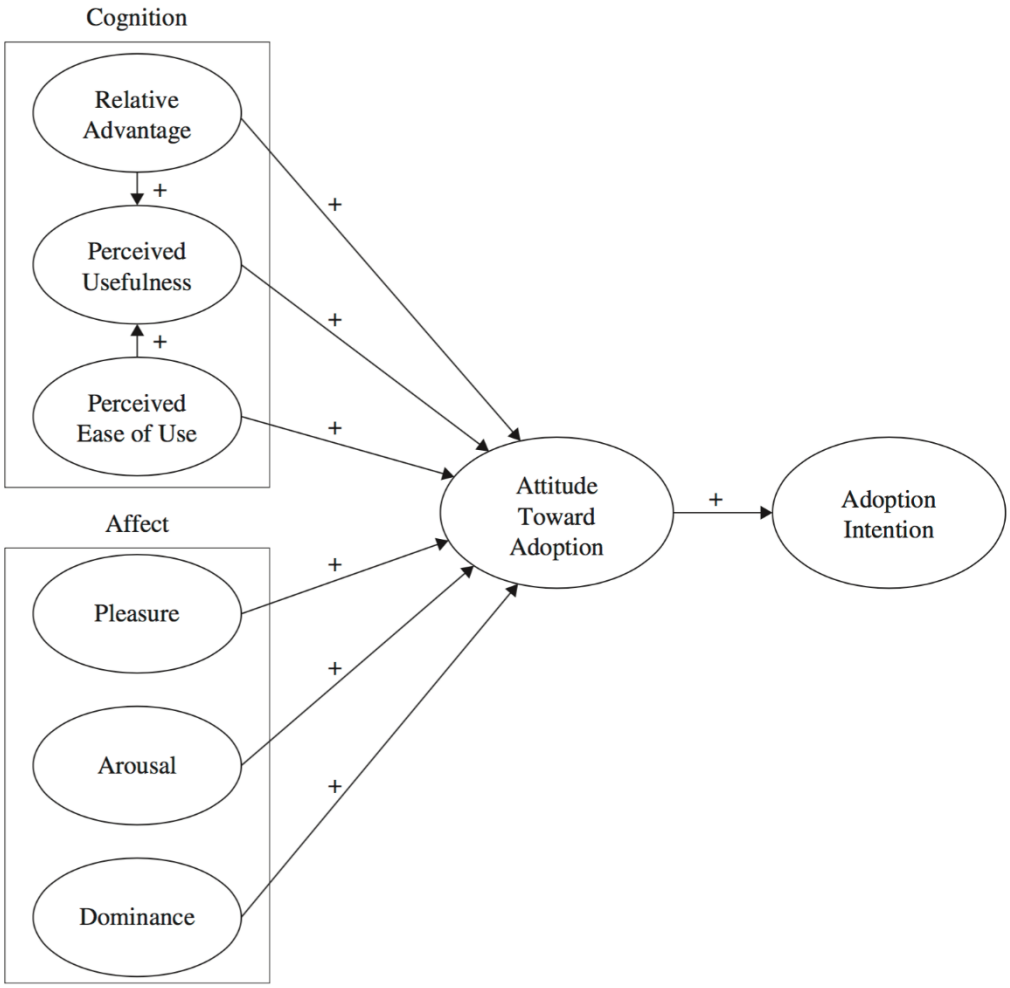

Figure 8. Proposed consumer acceptance of technology model by Kulviwat et al. (2007).

For the first part of the CAT-model (Consumer Acceptance of Technology) to be perceived as positive (the cognition part), the public should be able to notice that it is a good product, service, technology or any other kind of innovation. So the specifications of the innovations should be in line with expectations and interests of the innovations' public.

One of the things making the affective side of the CAT-model perceived as positive is trust in a specific technology, scientist, or related aspect. Trust in organizations is vital (Clark and Payne, 1997). Ever since the economic breakdown in 2008, it took years for the economic sector to recover and regain trust in the consumers — the people they so heavily rely on. For science however, this trust is just as vital. Scientists rely on funding from governments, industry, etc.; which all have to justify their actions to their stakeholders.

Since the current reputation of science, as stated by iGEM HQ, is not being open, scientists need to articulate better what problem needs to be solved, what the relative advantage is of their innovation towards this problem and what makes their work deserving the public's trust as being the best solution for this problem in the first place simultaneously. As an opponent, in iGEM, the participants are encouraged to share and publish their work, so the public is informed about their work. Since iGEM and its results could be much more recognized to get more people to know about it, we recommend several strategies on how and where the teams should be motivated to share their acquainted knowledge.

Openness and transparency is key in getting or retrieving trust. We think it is important to educate our future scientists in such a way that they will adopt the vision of integration of the stakeholders' interests while innovating and to communicate about it accordingly. A great place to start with this can for example be in the iGEM competition. To accomplish this integration, sharing knowledge is of great importance — towards all involved stakeholders.

Presenting an iGEM story

All teams deal with many different stakeholders while solving their selected problem. Even though the same problem and solution is presented to each of these stakeholders, not all communication methods will be as efficient for each stakeholder. For this, we advise the teams to make communications strategy; explore what stakeholders are involved, how they could be reached best and how the message should be told for this particular stakeholder group. Since main communication priority is towards the remaining scientific world, we will elaborate on that below.

As a side note, we would like to highlight the importance of being aware of the responsibility that scientists carry about their knowledge. Here you can think of different things, a negative example can be that the innovation might be misused with wrong intentions. However, this is not the only negative revealing; someone not understanding your approach in innovation, or being scared of something in your innovation is also not positive. For this, it is important to be and stay aware that you have to involve the thoughts and interests of your stakeholders in your story. Besides that, among others policy makers have been spurring innovators to include social and ethical aspects in their innovations (Lucivero et al., 2011). This means that ideally, the innovators (in this case the iGEM teams) are in contact with stakeholders during their innovation trajectory and accumulate the knowledge of and implement the wishes of these stakeholders already while they are making their product. So far, iGEM has been motivating their teams to implement this kind of "midstream modulation" (Flipse et al., 2013) (iGEM Human Practices, 2016), however the way the story is communicated might be improved in some cases.

One of the main communication aids of the iGEM teams is their Wiki page. This is mainly focused on reaching scientists and the iGEM community, meaning people with a scientific background. Though, comparing different Wiki pages to each other, even within the same university, many different structures arise on the Wikis. It is not immediately clear where to look for information if someone would be looking for it on an iGEM Wiki page. As opposed to scientific article, there is no clear structure. To create a similar clear structure in the iGEM Wiki pages, we suggest that each iGEM team structures its story similarly. Here we propose a structure in which iGEM teams can tell their story, keeping the importance of innovation science and the social and ethical aspects in mind.

- <u>Aim of the project</u>
  Just as in a scientific paper, it is important to set a context before running of to all results. It is important to know what the research is about and maybe even more importantly, why is it important that this specific research was conducted? What problem might this research solve and what implications would that have for the involved stakeholders? What stakeholders are actually involved in this topic (they may not be aware of it yet)? What kind of research was already done in this field? What questions are remaining and which of these are you trying to answer in this inquiry?

- Design stage
  For each problem, there are multiple scenarios possible. From each scenario though, another potential solution could arise. While the iGEM teams are familiarizing themselves with potential scenarios, they should be aware of the fact that there are things they do know, things they do not know and things they do not know they don't know it. Of course, this last category is the hardest to deal with. However, Schoemaker (1991) mentioned "series of scenarios help to compensate for the unusual errors in decision making", implicating the importance of these different scenarios. Which scenario is the most suitable in this specific context and what solution would work best, is mainly depending on the selection criteria elaborated below.

- Selection criteria for the design stage and their motivation
  After you have decided on a specific design space (stating what problem you exactly are trying to solve with this innovation) it is important for the stakeholders to show how you came to the selection of these potential solutions. For example technical aspects could be and issue, but also financial, cultural or any other criterion could make the scenario unsuitable. Basically, if something is not desired to be implemented in the solution, this should be communicated to the stakeholders. Furthermore, by applying the previous mentioned midterm modulation, these selection criteria can be formed in consultation with the stakeholders.

- The design and methods
  Since the desires of stakeholders and innovators are aligned at this stage, the real design can be described now. This means in the context of iGEM describing the different parts that were made and what their function is in the entire innovation. Also include the methods used with their argumentations.

- Results
  As the design needs to be tested and if possible confirmed, experiments are performed. These characterizations have a huge impact on new iterations of the innovation trajectory and eventually also for the perception of the innovation by stakeholders. What conclusions can be drawn from these results? And what further research would be necessary in this field and how can this innovation be implemented in real world conditions?

- Discussion
  Assuming the made innovation is successful and implemented in real world, this innovation is going to have an impact on all stakeholders. It is of importance that these stakeholders are involved about the consequences they are facing considering this new innovation. Due to the implementation of "midstream modulation" and further consideration of social and ethical aspects important to these stakeholders, this should help herewith. Besides that, new problems, which were faced during the innovation trajectory, could be an entrance to new research. This closes the circle of innovation.

The Wiki page is however not the only place to share obtained knowledge. Considering the timescale of the iGEM competition, knowledge could be shared in many different forms and at many different times. Here, we elaborate on some potential sharing possibilities that will contribute in making the iGEM community coherent. The different timings we have a look at are "During the competition", "After the competition" and "As old iGEM participants".

During the competition

As mentioned earlier: to strengthen a community, its continuity is vital and it therefore should attract new participants. Motivation has much influence on someone's behavior, in this case participating in the iGEM competition. According to Deci and Ryan (1975), intrinsic motivation is opposed to external motivation much stronger. Even though intrinsic motivation is much stronger, it is much harder to influence. For each person it might be different what motivates him or her. A lot of effort is necessary and with no certainty. So, to be able to motivate more people at once, it is advisable to motivate externally. Two examples of external motivation are elaborated below.

Positive experiences of old iGEM team members

Success stories sell. When someone wins a prize, all journalists want to write their articles about it, because this is news that will sell. Everyone will want to know that news. Humans are captured by it; by its uniqueness, by its visual impact, but overall by its success. Proximity in these success stories would even help more (Galtung and Ruge, 1965). In most optimistic case, people that are close to the potential new generation tell these success stories (for example fellow students, PhD students, teachers or others in academia). Some sort of proud takes over then. This could be a strong method to motivate potential new iGEM participants. While making sure these success stories are above all also framed as inspirational, this could demonstrate the potential success new teams also could achieve. This combined with aspiration (intrinsic motivation) could lead towards a new-motivated generation for the iGEM community.

Financial motivation combined with sponsorship from governments

Finances can be an extremely strong external motivator. For example, in the Netherlands the government's aim was to get more teachers for high schools. For this, a campaigning program was set up for a couple of years, in which students who would get their master's degree in teaching, they would receive a scholarship of €5000. A potential translation to the iGEM competition could be a collaboration between the innovation departments of the governments and the iGEM competition. Within the Netherlands, the Topsectors are for example "responsible" for tracking innovations in different industry disciplines. The iGEM headquarters can for example try to collaborate with different government institutions that are also interested in innovations within this field. Then teams can be motivated to participate in an additional part of the competition, where the different teams need to prove to one of the selected governments that they are worth it to receive funding, enabling them to continue with their research, start a business etc. This can contribute significantly to innovations.

Assuming the students were motivated enough at this moment to become participants in iGEM, they have indirectly also chosen to become members of the iGEM community. However, we would like them to become active members and we would like them to stay active members. This means that we would like to motivate these new participants to be active in sharing knowledge and experiences towards each other and people that are potentially interested in iGEM. Sharing knowledge starts already with consistency in how different teams present their story on their Wiki pages. As described earlier, the iGEM community would benefit if the iGEM community has a specific, recognizable and useful way of communicating the innovation trajectories done by iGEM teams. Besides that there are other ways of share knowledge, during the competition and after, with other teams as well as with remaining scientists and other stakeholders.

Share knowledge inbetween iGEM teams

To start, the iGEM teams are able to share their knowledge with each other. Since every team gets its lectures at a different institution, from different lecturers, perceptions and specific knowledge are different between institutions. Collaborations as currently performed, are an excellent way of dispersing the knowledge; letting the teams benefit from the knowledge available. Also, not all teams might have all equipment available at their own institution. This might be due to prioritization of the specialization (the equipment is not a necessity on a daily basis) or for example due to financial issues. Then, it is possible to ask another team to help out.

Even though these kinds of collaborations are a good start, it could be more. Collaborations are at this moment an obligatory part of the competition and we suspect that this is the reason the teams seek for collaborations in the first place. If more teams are using the same components, these teams could also try to troubleshoot together, making this more efficiently. If it would be made more easily to establish these kinds of collaborations, teams might also be intrinsically more motivated to enhance collaborations. Helping each other gives a feeling of satisfaction. Since this satisfactory feeling was due to the iGEM community, this new generation might also be more dedicated to keep acquired contacts close. This also helps again in making the iGEM community coherent.

Using the Slack application

One of the currently facilitated methods of communicating and knowledge sharing is via the iGEM forum. This was proposed as a method in the beginning of the iGEM competition. Back in the day, forums were used much more extensively. From our investigation we concluded that the current iGEM forum is underused with only about 1500 views in the last year. Besides that, not many new threads are created each year. The main platforms we used to connect and communicate with other teams were Facebook groups, emails and Twitter. A drawback about these platforms is that they do not let the teams seek for new collaborations and ask or answer questions. In these platforms, you would have to find a team manually about whom you would know they are able to help and send them an email. If collaborating with this team does not work out, you would have to look for another team manually again. Since the iGEM forum seems to be outdated and underused, we propose to replace the iGEM forum with a Slack team.

Slack is a chat application aimed at large teams and companies. The advantage of Slack over other messaging apps is that all comments and files exchanged are searchable and Slack contains the possibility to create different channels between the members of the team. It allows communities, groups or teams to join through a specific URL or invitation so replacing community platforms such as Facebook or LinkedIn (Wikipedia, 2016). Besides that, no personal information such as phone numbers is necessary to be a member of such a team. So “rather than host a forum or digital community themselves, or use social media platforms to engage, many community managers are turning to Slack as a place to quickly and easily build tight-knit communities” (Hootsuite blog, 2016), because ”Slack is more like instant messaging, forums, and email all rolled into one app” (PC mag, 2016).

The main use of Slack is in industry and collaboration of big teams. It has even been called “the killer of email”. It provides a central place for communication with real time messages instead of emails, reducing the time spent replying emails and increasing productivity and communication. The messages tend to be shorter and more casual than emails, making them more personal, easier and faster to reply (MIT Technology Review, 2016).

The reason of this migration to Slack is the ease of use of the service, the exclusivity of the chats and that it fits for use of communities and platforms. This translates in usage numbers as in its first year, 2015, it reached 500.000 daily active users, to more than quadruple them in their second year with 2.3 million daily active users.

There should be a general team with all the team accounts where general discussions can take place and collaborations/discussions during the Jamboree so teams can communicate easier. Besides those different channels for example with teams from the same area, same topic, undergrad, overgrad and high school can be established. Additionally, we propose that initially each team should have one account as a team and then in a later phase we can add all team members as well.

After the competition

Assuming the Giant Jamboree was a success, the participants are enthusiastic about it and might be willing to stay involved in the iGEM community. At this moment, it is important to keep this enthusiasm high. Since the phases in which the undergrad and overgrad teams are at in their study program after the Jamboree, it is advisable to approach these groups differently.

Undergrad teams

It will most likely take quite some time (years) until the undergrad teams are graduated and would have a significant amount of time to dedicate to the iGEM community again. For this reason, it is advisable to keep the expectations of devotion low. For example pleasant and enjoyable activities are good. It can also help to motivate them to keep in touch with other iGEM teams, knowing how they are doing in life and bond over iGEM activities. At their turn, these social activities have a positive impact on their relations, creating proximity. In the meanwhile, iGEM headquarters should stay up to date on when these originally undergrad teams would be available to actively participate in the iGEM community.

Overgrad teams

These iGEM teams are very likely to be busy with graduation projects and finishing their study program. It is not difficult to understand that this has the highest priority for these team members and not much involvement can be expected immediately after the Jamboree. However, after they have been able to finish their study program, they would even be more valuable for the iGEM community if they could actively participate in it. Whether they are going for a PhD position and continue in research, start a career in industry or any other discipline, a side project like iGEM is more likely to fit in their lives if it is incorporated from the beginning. For this, we advice the iGEM headquarters to provide the overgrad teams with a short survey at the Jamboree to make a prospect of who would be willing to be involved (e.g. advising new teams, volunteering at the Jamboree, or anything else) and from which moment on they would be available. Headquarters should communicate clearly what expectations they have considering this collaboration and the participant should communicate how much effort and time they would be willing and are able to put into the iGEM community. From here, mutual trust, motivation and effort to keep the relationship working is necessary.

As old iGEM participants

As old iGEM participants and active members of the iGEM community, their task is to have interactions with the new iGEM participants and sort of form the bridge between iGEM headquarters. This new iGEM generation will in turn feel grateful that they were able to get help form the community and are more probable to help newer generations in the future. As for the old iGEM participants, it could establish a happy feeling that they could return something to the community in the same way that they received a grateful feeling earlier. Like this, sharing of knowledge will be positive enforced.

Conclusions

Concluding, iGEM headquarters has made a huge effort to make the iGEM community a growing success as it is today. The past decade, it has grown enormously in people involved and in interested people. To strengthen the community even more, we think the value of sharing knowledge is extremely powerful. While sharing knowledge both internally and externally, the community strength as well as the involvement with other stakeholders will be improved.